

CLAIMS:

1. A method for initializing recording films of an optical recording medium including a plurality of recording layers each including a recording film and which is formed so that a transparent intermediate layer is interposed between each adjacent pair of the recording layers, by
5 projecting a laser beam whose power can be controlled within a predetermined range onto the recording films and simultaneously crystallizing and initializing the recording films, the method for initializing recording films of an optical recording medium comprising
10 steps of setting a power of the laser beam and a position of a focus of the laser beam so that energy of the laser beam projected onto each of the recording films is equal to or higher than a minimum initialization energy which can crystallize and initialize the recording film irradiated with the laser beam, and projecting the laser beam onto the recording films of the
15 optical recording medium.
2. A method for initializing recording films of an optical recording medium in accordance with Claim 1 wherein the laser beam is focused so that the focus thereof is located in a transparent intermediate layer.
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3. A method for initializing recording films of an optical recording medium in accordance with Claim 2 wherein the laser beam is condensed by an objective lens onto a transparent intermediate layer to have a depth of focus D so that $d \geq \lambda/NA^2$ is satisfied, where d is a thickness of the
25 transparent intermediate layer, λ is a wavelength of the laser beam and NA is a numerical aperture of the objective lens.
4. A method for initializing recording films of an optical recording

medium in accordance with Claim 2 wherein the optical recording medium includes a first recording layer formed close to a light incident plane on which the laser beam is impinged, a second recording layer formed far from the light incident plane and a transparent intermediate layer formed between the first recording layer and the second recording layer and which comprises steps of setting the power of the laser beam and the position of the focus of the laser beam so as to satisfy $P_{L0}/A0 \geq P0$ and $T \times P_{L0}/A1 \geq P1$, where P_{L0} is the energy of the laser beam projected onto the first recording layer, $A0$ is an area of a spot of the laser beam projected onto the first recording layer, $A1$ is an area of a spot of the laser beam projected onto the second recording layer, T is a light transmittance of the first recording layer, $P0$ is the minimum initialization energy of the laser beam per unit area required for crystallizing and initializing a recording film included in the first recording layer and $P1$ is the minimum initialization energy of the laser beam per unit area required for crystallizing and initializing a recording film included in the second recording layer, and projecting the laser beam onto the first recording layer and the second recording layer of the optical recording medium.

5. A method for initializing recording films of an optical recording medium in accordance with Claim 3 wherein the optical recording medium includes a first recording layer formed close to a light incident plane on which the laser beam is impinged, a second recording layer formed far from the light incident plane and a transparent intermediate layer formed between the first recording layer and the second recording layer and which comprises steps of setting the power of the laser beam and the position of the focus of the laser beam so as to satisfy $P_{L0}/A0 \geq P0$ and $T \times P_{L0}/A1 \geq P1$, where P_{L0} is the energy of the laser beam projected

onto the first recording layer, A0 is an area of a spot of the laser beam projected onto the first recording layer, A1 is an area of a spot of the laser beam projected onto the second recording layer, T is a light transmittance of the first recording layer, P0 is the minimum initialization energy of the laser beam per unit area required for crystallizing and initializing a recording film included in the first recording layer and P1 is the minimum initialization energy of the laser beam per unit area required for crystallizing and initializing a recording film included in the second recording layer, and projecting the laser beam onto the first recording layer and the second recording layer of the optical recording medium.

6. An apparatus for initializing recording films of an optical recording medium including a plurality of recording layers each including a recording film and which is formed so that a transparent intermediate layer is interposed between each adjacent pair of the recording layers, by projecting a laser beam onto the recording films and simultaneously crystallizing and initializing the recording films, the apparatus for initializing recording films of an optical recording medium comprising a semiconductor laser adapted for emitting a laser beam and movable in a direction perpendicular to a surface of the optical recording medium, an objective lens for converging the laser beam and a controller for controlling overall operation of the apparatus for initializing recording films of an optical recording medium, the controller being constituted so as to set a power of the laser beam emitted from the semiconductor laser and a position of the semiconductor laser in the direction perpendicular to the surface of the optical recording medium so that energy of the laser beam projected onto each of the recording films is equal to or higher than a minimum initialization energy which can crystallize and initialize the

recording film irradiated with the laser beam, and projecting the laser beam onto the recording films of the optical recording medium.

7. An apparatus for initializing recording films of an optical
5 recording medium in accordance with Claim 6 wherein the controller is constituted so as to set the position of the semiconductor laser in the direction perpendicular to the surface of the optical recording medium so that the focus of the laser beam is located in a transparent intermediate layer.

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8. An apparatus for initializing recording films of an optical
recording medium in accordance with Claim 7 wherein the semiconductor laser and the objective lens are selected to produce a depth of focus D so that $d \geq \lambda/NA^2$ is satisfied, where d is a thickness of the transparent
15 intermediate layer, λ is a wavelength of the laser beam and NA is a numerical aperture of the objective lens.

9. An apparatus for initializing recording films of an optical
recording medium in accordance with Claim 7 wherein the optical
20 recording medium includes a first recording layer formed close to a light incident plane on which the laser beam is impinged, a second recording layer formed far from the light incident plane and a transparent intermediate layer formed between the first recording layer and the second recording layer and which further comprises a memory for storing,
25 for each kind of the optical recording media, a light transmittance $T1$ of the first recording layer, the minimum initialization energy $P0$ of the laser beam per unit area required for crystallizing and initializing a recording film included in the first recording layer, the minimum

initialization energy P_1 of the laser beam per unit area required for crystallizing and initializing a recording film included in the second recording layer and a light transmittance T_2 of the optical recording medium between the light incident plane and the first recording layer, the
5 controller being constituted so as to set the power of the laser beam emitted from the semiconductor laser and the position of the semiconductor laser in the direction perpendicular to the light incident plane so as to satisfy $T_2 \times P/A_0 \geq P_0$ and $T_1 \times T_2 \times P/A_1 \geq P_1$, where P is the power of the laser beam emitted from the semiconductor laser, A_0 is
10 an area of a spot of the laser beam projected onto the first recording layer and A_1 is an area of a spot of the laser beam projected onto the second recording layer.

10. An apparatus for initializing recording films of an optical
15 recording medium in accordance with Claim 8 wherein the optical recording medium includes a first recording layer formed close to a light incident plane on which the laser beam is impinged, a second recording layer formed far from the light incident plane and a transparent intermediate layer formed between the first recording layer and the
20 second recording layer and which further comprises a memory for storing, for each kind of the optical recording media, a light transmittance T_1 of the first recording layer, the minimum initialization energy P_0 of the laser beam per unit area required for crystallizing and initializing a recording film included in the first recording layer, the minimum
25 initialization energy P_1 of the laser beam per unit area required for crystallizing and initializing a recording film included in the second recording layer and a light transmittance T_2 of the optical recording medium between the light incident plane and the first recording layer, the

controller being constituted so as to set the power of the laser beam emitted from the semiconductor laser and the position of the semiconductor laser in the direction perpendicular to the light incident plane so as to satisfy $T_2 \times P/A_0 \geq P_0$ and $T_1 \times T_2 \times P/A_1 \geq P_1$, where P is the power of the laser beam emitted from the semiconductor laser, A0 is an area of a spot of the laser beam projected onto the first recording layer and A1 is an area of a spot of the laser beam projected onto the second recording layer.

11. An optical recording medium comprising a substrate, and a second recording layer including a recording film, a transparent intermediate layer, a first recording layer including a recording film and a light transmission layer on which a laser beam is impinged formed on the substrate in this order, the first recording layer and the second recording layer being formed so as to satisfy $0.8 \leq P_0/P_1 \leq 1.2$, where T is a light transmittance of the first recording layer, P0 is the minimum initialization energy of the laser beam per unit area required for crystallizing and initializing the recording film included in the first recording layer and P1 is the minimum initialization energy of the laser beam per unit area required for crystallizing and initializing the recording film included in the second recording layer.

12. An optical recording medium in accordance with Claim 11 wherein the recording film included in the first recording layer and the recording film included in the second recording layer contain a phase change material as a primary component.